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Purpose/Objective: To compare dose sparing to stomach, duodenum and small bowel using radiobiological endpoints for 3D and intensity-modulated arctherapy (IMAT) plans for locally advanced pancreatic cancer (LAPC).
Materials and Methods: For 11 patients treated with chemo-radiotherapy, the original 3D conformal treatment plan (50.4 Gy / 28 fr to the tumour and elective nodes, PTV5040, then 9 Gy / 5 fr to the primary tumour, PTV5940) was compared retrospectively to an IMAT plan with a simultaneous integrated boost(59.4 Gy (PTV5940) and 52 Gy (PTV5040) in 33 fractions). In both techniques, target coverage ($D_{99\%}$ >95% prescribed dose) and dose constraints to critical organs (cord D_{max}< 40 Gy, liver $D_{50\%}$ <20 Gy and kidneys, R kidney $D_{50\%}$< 20 Gy, L kidney $D_{30\%}$ < 20 Gy) were strictly respected. Plans were compared using the PTV conformity index $CI_{95\%}$ and dose metrics of gastro-intestinal (GI) organs (stomach: V_{50} and D_{max} to 2cc, combined stomach and duodenum (StoDuo): V_{50} and small bowel: V_{45}). NTCP modelling of stomach, duodenum and small bowel was used to rank plans by estimating GI toxicity, using the full range of NTCP parameter values for these organs found in the literature.
Results: Improved dose sparing of critical organs for all 11 patients was observed with the IMAT technique, due to higher dose conformation of the target volume: IMAT mean PTV5940 $CI_{95\%}$= 1.08 ± 0.03 vs 3D mean PTV5940 $CI_{95\%}$ = 1.83 ± 0.25, p<0.001. In particular, dose constraints for L kidney were met for 11/11 patients for IMAT and only 6/11 for 3D. A reduction in acute toxicity of small bowel may be possible using IMAT due to the reduction of the V_{45} volume (IMAT mean 285.1 ±124.1 cm^3 vs 3D mean 348.8±147.3 cm^3, p<0.001). A similar reduction in high dose was seen for StoDuo when using IMAT: StoDuo V_{50} (IMAT mean 26.4±5.8 cm^3 vs 3D mean 33.7±8.1 cm^3 p<0.0001). For stomach, although there was no significant difference in the two techniques for the Stomach D_{max} (3D mean = 59.7±2.6 Gy and IMAT mean= 58.3±3.6 Gy), a reduction in the Stomach V_{50} volume was observed with IMAT (IMAT mean 18.7±12.3 cm^3 vs 3D mean 28.1±20.4 cm^3, p=0.009). Using NTCP estimates of GI toxicity to rank plans showed that the IMAT technique was always preferable to 3D conformal therapy, independent of the values used in the radiobiological modelling.
Conclusions: The predicted dose sparing obtained with the IMAT technique is particularly important in the context of concurrent chemo-radiotherapy for pancreatic cancer where GI toxicity is often a limiting factor. For stomach, duodenum and small bowel, NTCP analysis predicts a significant advantage in using IMAT. Using radiobiological endpoints presents a simple method for obtaining relative plan ranking, which is robust to the choice of values used in the NTCP modelling.

PO-0814
Dose escalation with simultaneous IMRT for anal cancer with minimum bowel toxicity
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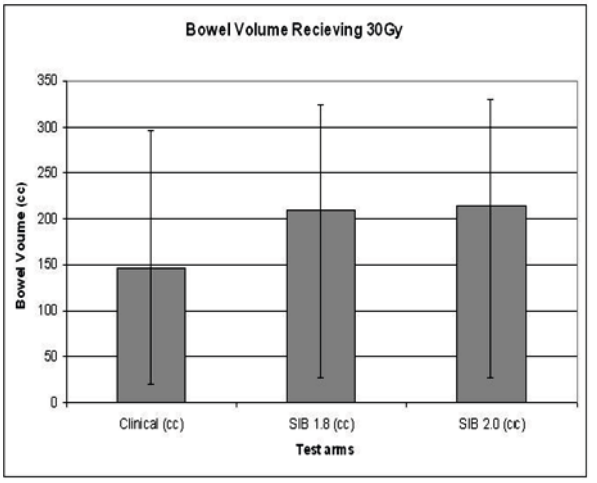
Purpose/Objective: Higher tumour stage is an independent predictor of local failure. We present a retrospective planning study to determine the feasibility of dose escalation in very advanced anal cancers using a simultaneous integrated boost (SIB) with a small bowel dose constraint of V_{30Gy}≤300cc (Devisetty et al 2009).
Materials and Methods: Five consecutive CT datasets of patients with stage T3N2-T4N3 anal canal were identified. Planning target volume 1 (PTV1) included tumour and pelvic elective nodal areas; PTV2 included primary tumour and involved nodes. Three types of IMRT plans were generated. The CLINICAL plan utilised a sequential phase1 inverse-planned 7-field IMRT followed by either a conformal or inverse-planned phase 2. The SIB plans were prescribed 42Gy in 1.5Gy/fraction to PTV 1 and 50.4Gy (SIB1.8) and 56Gy (SIB2.0) to PTV2 respectively. Prescription dose to the CLINICAL plan was 30.6Gy and 19.8Gy in 1.8Gy/fractions to PTV1 and PTV2 respectively. The plans were optimised to meet small bowel, genitalia, bladder and femoral head constraints. Patients were previously treated with the CLINICAL plan and did not experience high grade acute bowel toxicity. Maintaining the same risk of gastro-intestinal toxicity as achieved in the CLINICAL plan was a priority. The CLINICAL plan was used as the reference and the small bowel dose constraint V_{30Gy}≤300cc was aimed for in the SIB plans. Small bowel V_{30Gy} and coverage of PTV2 by 95% prescription isodose and conformity index (CI) were compared.
Results: All plans achieved the minimum dose coverage of 95% prescription dose. No plan exceeded a maximum dose of 105% to 2% of the PTV volume. The SIB test arms had better conformity index (CI) than the clinical plan. 4/5 patients met the bowel dose constraint of V_{30Gy}≤300cc. One case failed to achieve small bowel constraint as 223cc bowel overlapped PTV.

	Clinical	SIB 1.8	SIB 2.0
Bowel V_{30} (cc)	147.1 (20.1-295.5)	209.2 (26.7-324.4)	214.7 (27.4-330.6)
PTV $D_{98\%}$ (Gy)	49.0 (48-49.4)	48.3 (47.9-48.5)	53.5 (53.5-53.9)
PTV $D_{2\%}$ (Gy)	51.9 (51.7-52.3)	52.3 (52.2-52.4)	58 (57.8-58.4)
PTV $D_{50\%}$ (Gy)	50.6 (50.4-50.7)	50.4 (50.4-50.5)	55.9 (55.9-56.1)
PTV $D_{95\%}$ (Gy)	49.3 (48.8-49.7)	48.7 (48.4-48.9)	54 (54-54.3)
CI	1.40	1.15	1.15



Conclusions: SIB IMRT is achievable whilst meeting the bowel constraint of V_{30Gy}≤300cc providing that the physical volume of the bowel and PTV overlap is kept below 190cc. Acceptable small bowel dose increases are seen in the SIB plans compared to the clinical plan. Dose escalation is achievable for prescription doses of 50.4Gy and 56Gy to the primary volume and plans for escalation to 64.4Gy are in progress.
Reference
Devisetty K, Mell LK, Salama JK et al. A multi-institutional acute gastrointestinal toxicity analysis of anal cancer patients treated with concurrent intensity-modulated radiation therapy (IMRT) and chemotherapy. Radiother and Oncol 2009;93:298-301.

PO-0815
Comparative dosimetric study of two dose-calculation algorithms, in RapidArcô radiotherapy treatments
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Purpose/Objective: The accurate and fast dose calculation is an essential requirement of modern Radiotherapy (RT).The ability to predict dose with high accuracy is usually associated with the probabilistic Monte Carlo methods, but with long calculation times for use in daily clinical practice. The dose-calculation algorithms used in clinical practice, such as pencil-beam convolution and the convolution/superposition (method used in Anisotropic Analytical Algorithm - AAA) typically include models to significantly reduce the computation time (pre-calculated dose kernels in water with Monte Carlo), but with decreasing accuracy, especially in the presence of heterogeneities. The deterministic dose-calculation algorithm Acuros® XB for photons, which was recently implemented in the treatment planning system (TPS) Eclipse™ is able to fulfill these two